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ABSTRACT

The study examined the ways in which different categories of discourse marker affect how well foreign college students understand university lectures, and specifically, the effects of macro markers (those indicating overall organization) and micro markers (functioning as fillers, indicating links between sentences). Four versions of an American history lecture were developed: a baseline version without special signals of discourse organization, a version with micro markers, one with macro markers, and one combining micro and macro markers. The four versions were assigned at random to different classes of pre-university and university groups of students of English as a second language. The students' comprehension was measured by three instruments: a cloze recall test, a multiple-choice test, and a true-false test. It was found that macro markers led to better recall of the text material than micro markers, in either the micro or the micro-macro version. It is suggested that more emphasis be placed on macro markers in second language classroom instruction and materials. (MSE)

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THE EFFECT OF DISCOURSE MARKERS ON THE COMPREHENSION OF LECTURES

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THE EFFECT OF DISCOURSE MARKERS ON THE COMPREHENSION OF LECTURES *

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Introduction.

With greater numbers of non-native speakers of English entering English medium institutions of higher education around the world, the provision of appropriate English language training as a preparation for academic study becomes increasingly important. In the United States, all major universities now offer specialized English language courses for foreign students, dealing with the use of English in such areas as advanced reading, writing term papers, discussion skills, lecture comprehension, and note taking. The growing demand for such courses has led to the need for research into the processes underlying academic performance in a second or foreign language, which can provide input to teacher training as well as to the development of appropriate curriculum and instructional materials. This paper deals with the university lecture and describes a study which was conducted to investigate how different categories of discourse markers affect how well foreign students understand university lectures.

1. Listening Comprehension Processes.

Research on the processes of listening comprehension in both first language and second language listening is in its infancy. Still, a considerable body of related research into the cognitive processes underlying comprehension has led to a greater

understanding of the nature of listening comprehension (e.g. Clark and Clark 1977: Richards 1983). Two basic processes that have been identified are referred to as bottom-up processing and top-down processing. Bottom-up processing refers to the analysis of incoming data and categorizing and interpreting it on the basis of information in the data itself. With respect to the comprehension of language, bottom up processes would be, for example, those which assign grammatical status to words on the basis of syntactic and morphological cues and which assign topics and meanings on the basis of syntax and word order and the meanings of lexical items used in the message. Top-down processing makes use of prior knowledge as part of the process of comprehension. This may take many forms, including expectations about the topic and structure of a piece of discourse based on real world knowledge and reference to various types of frames, schemas and macro-structures (see Van Dijk 1977, Rumelhart 1977, Meyer 1984, and especially L2 research on schema theory by Carrell 1984). Top-down processing involves prediction and inferencing on the basis of hierarchies of facts, propositions, and expectations, and it enables the listener or reader to by-pass some aspects of bottom-up processing. On encountering the topic of "going to the dentist" for example, we refer to knowledge about the participants in the situation, their roles and purposes, and the typical procedures adopted by dentists and their consequences. Comprehension is viewed as a combination of both bottom-up and top-down processing. As Adams and Collins put it (1979):

> An important aspect of a schema-theoretic account of reading comprehension is that top-down and bottom-up processing should be occurring at all levels of analysis simultaneously. The data that are needed to instantiate or fill out the schemata become available through bottom-up processing; top-down processing facilitates their assimilation if they are anticipated or are consistent with the reader's conceptual set. Bottom-up processing ensures that the reader is sensitive to information that is novel or that does not fit his or her ongoing hypothesis about the context of the text; top-down processes help the reader to resolve ambiguities or to select between possible interpretations of the incoming data. Through the interactions between top-down and bottom-up processing, the flow of information through the system is considerably constrained. (p. 5)

The interactions of these two levels of processing are well illustrated in the case of understanding lectures.

2. Listening to lectures.

The function of lectures is to instruct, by presenting information in such a way that a coherent body of information is presented, readily understood, and remembered. Several distinct modes of lectures have been distinguished in research on the nature of academic discourse. Dudley-Evans and Johns (British Council 1981) establish three categories of lectures: 1) a reading style in which the lecturer reads from notes or follows a tightly structured and organized outline; 2) a more informal conversational style in which the lecturer talks his/or her way through the lecture, with or without notes; 3) a rhetorical syle in which the lecturer delivers a "performance". The present study deals primarily with lectures in the reading style.

In view of the didactic focus of lectures, the structuring and organization of information within a lecture has been assumed to be an essential aspect of its comprehensibility. Within applied linguistics, researchers interested in identifying those

aspects of lecture structure which might be relevant focii in training non-native listeners have examined how the organization of information within a lecture is signalled. Cook (1975) describes the macro-structure of a lecture as being composed of a number of "expositions". These consist of an optional episode of expectation, an obligatory focal episode, an obligatory developmental episode together with optional developmental episodes, and an obligatory closing episode. At the level of micro-structure, episodes are described in terms of moves. For example a concluding move is a justifactory statement, a focal episode with a concluding function, or a summary statement; a summarizing move gives a resume of the immediately preceding discourse. A similar approach to the analysis of written rhetorical structure has been adopted by Carrell (1984), who has investigated its effects on L2 reading comprehension. Both Cook, and Murphy and Candlin (1979) focus on how the rhetorical organization of a lecture is signalled. Cook examines the functions of connectives and other devices which serve as indicators of topic continuation. Discourse markers which signal the information structure of discourse by emphasizing directions and relations within discourse include phrases such as "Now, getting back to our main point..." Murphy and Candlin identify a number of markers of the rhetorical organization of lecture discourse, including what they refer to as markers (e.g. "well, right, now"), starters (e.g. "well now let's get on with ..), and metastatements (e.g."I want to mention two types of generator"). These discourse signals also reflect the interactional nature of

the lecture situation and are probably more frequent in a conversational style than a reading style.

Studies of listening problems for non-native listeners have confirmed that they do indeed have difficulties recognizing signals and markers of organization of information within lectures. In a study of lecture comprehension problems encountered by Chinese students at UCLA, Yuan (1982) observes:

> In general, the subjects were rather weak at paying attention to the sequence of the lecture because of their neglect of the logical connectors of sequence and their lack of recognition of transition from one main idea to another. Besides, they paid more attention to decoding the speech sentence by sentence than to extracting the science information from the lecture through understanding the rhetorical nature and functions of both textual and lecture discourse. (p. 48)

There have, furthermore, been a few experimental attempts to investigate what features of lectures might aid L2 learners' comprehension. Several studies (Long 1983, Cervantes 1983, Kelch 1984) explored the effects of repetitions, paraphrases, rate of speech, or syntactic complexity. Two studies examined features of discourse organization. Chaudron (1983) studied the effects of topic signalling in experimental lectures on ESL learners' immediate recall of the topic information. He found that recall was significantly better for a repeated topic than for more complex signalling of topic change. Sawa (1985) manipulated two factors in recorded lectures: the repetition and paraphrasing of information, and signalling of major segments and emphasis (especially by rhetorical questions). He tested the effects of each of these separately and in combination, on intermediate level ESL listeners' post lecture free recall. Sawa's results

showed no significant overall differences in recall between lecture versions, but this lack of differences may be attributable to the generally low recall rate of the subjects on the free recall. A more immediate measure such as a cloze procedure may reveal difference. Sawa's subjects also had very little time available for recall (about four minutes for a six minute lecture).

Some ESL instructional materials for the teaching of comprehension of lectures acknowledge the role of discourse markers in aiding comprehension, and give practice in recognizing different kinds of discourse markers and their functions within lectures. In Listening and Learning (Young and Fitzgerald 1982), for example, exercises are provided which train learners to identify discourse markers with the functions of addition, comparision, contrast, exemplication, explanation, restatement, result, sequence, summation and transition.

The research cited above suggests that, in addition to possible prior knowledge of the topic of a lecture, the L2 listener may benefit from knowledge of the macro-structure and discourse organization of lectures. Prior knowledge of this sort helps top-down processing by initiating expectations and predictions about the lecture. These expectations are then confirmed and supported by the speakers' use of discourse signals of the relationship between successive episodes and moves within the lecture. Such discourse signals, like Murphy and Candlin's starters and metastatements, could be termed "Macro markers."

At the same time, some research suggests that the speaker's use of signals such as "well", "so", "now" (which could be called

"Micro markers") serve as filled pauses giving listeners more time to process individual segments of a piece of discourse; they hence provide more opportunities for bottom-up processing. Research on pausing phenomena in teacher talk (Chaudron 1983: Chaudron forthcoming) has found that both filled and unfilled pauses increase in frequency or in length when native speakers address learners of low proficiency, presumably reflecting the speaker's attempt to provide greater opportunity for bottom-up processing. Such pauses provide futher time for processing and assist in segmenting discourse into meaningful units for higher level processing. However, the precise functional effects of different kinds of markers (e.g. those functioning as signals of the macro-structure as opposed to those functioning as fillers) requires further clarification. It is this question which the present study seeks to address.

3. Research Questions

The present study is intended to explore the effects of discourse signals and markers in lectures on second language learners' comprehension. The relationship between top-down and bottom-up processing was targeted by posing the following two questions:

1) What is the effect on L2 learners' comprehension of lectures of the use of discourse markers which indicate the overall organization of lectures that is, macro markers which signal the macrostructure of a lecture through highlighting major information in the lecture and the sequencing or importance of that information.

2) What is the effect on L2 learners' comprehension of lectures of the use of micro markers, which indicate links between sentences within the lecture, or which function as fillers?

In order to answer these questions, a lecture on American history was prepared, based on a natural, live performance on the topic by an ESL teacher. Four different versions of the lecture were recorded, each version including a different combination of macro and micro discourse markers. These lectures were then played to second language learners of different ability levels, and measures were taken of their comprehension.

4. Hypotheses

It was hypothesized that learners would comprehend the information in the lecture better when more discourse markers were included, in particular,

H1: L2 learners would comprehend the lecture better when Micro markers were added than when no markers were added.

H2: L2 learners would comprehend the lecture with Macro markers better than the lecture with only Micro markers.

H3: L2 learners would comprehend best the lecture with both Micro and Macro markers.

In order to test these hypotheses, the following procedures were employed.

5. Method

5.1 Materials

5.1.1 Lectures

A video tape and transcript of a natural lecture presented to ESL university students was used as source material. This

lecture, which dealt with the expansion of the United States from 13 colonies to an imperial nation, was condensed to about a seven page written passage. This passage, the "Baseline" version, did not include any special signals of discourse organization or linking between sentences, other than what was absolutely necessary to convey the meaning of the lecture.

A second version of the lecture, the "Micro" version, was then constructed, in which various markers of intersentential relations, framing of segments, and pause fillers, were inserted. No other changes in the content of the lecture were made. Examples of these markers are:

temporal links -- then, and, now, after this, at that time

causal links -- because, so

contrastive relationships - but, actually

relative emphasis -- you see, unbelievably, of course

framing/segmentation -- well, OK, all right?

Every attempt was made to keep any of these markers from adding semantic information to the lecture. The relationships encoded by the markers were, typically, already evident in the content of the text.

A third version was also constructed, called the "Macro" version, containing signals or metastatements about the major propositions within the lecture, or the important transition points in the lecture. For example:

what I'm going to talk about today...

let's go back to the beginning...

this brought about new problems...

Again, these added no new propositional content to the lecture.

The final version was simply a combination of versions 2 and 3, called the "Micro-Macro" version. The following are examples of sections showing all four versions:

Baseline versions:

> The United States came into existence officially in 1783 after 8 years of war...
>
> By 1803, the original 13 colonies had doubled in size...

Micro versions:

> Well, the United States came into existence officially in 1783 after 8 years of war...
>
> And so, by 1803, the original 13 colonies had doubled in size...

Macro versions:

> To begin with, the United States came into existence officially in 1783 after 8 years of war...
>
> What we've come to by now was that by 1803, the original 13 colonies had doubled in size...

Micro-Macro versions:

> Well, to begin with, the United States came into existence officially in 1783 after 8 years of war...
>
> And so, what we've come to by now was that by 1803, the original 13 colonies had doubled in size...

These four versions were then separately recorded by a male speaker in a professional studio, at a moderately slow rate of speech. Table 1 shows the total durations and rate of speech for each lecture version. (1)

Insert Table 1 about here

5.1.2 Comprehension measures

Three measures of the learners' comprehension of the lectures were pilot tested and revised before inclusion in the study. The first was a recall cloze measure, which involved a sample of sections from the lecture. This sort of test has been shown to be a relatively reliable measure of comprehension (Henning, Gary and Gary 1981, Chaudron, In press). (2)

The second comprehension measure was a ten-item multiple choice test with four alternate responses, covering the material in the entire lecture. The third was a ten-item true-false test covering the entire content. These were to be filled in by the listeners following the completion of the lecture.

5.2 Subjects

Two groups of subjects were tested using these materials. These will be referred to as the pre-university and the university groups. The pre-university group were 71 ESL students enrolled in sections of two listening courses in an intensive English language program at a private college in Hawaii. The university group were of a higher level of proficiency: 81 ESL students enrolled at the University of Hawaii, who were taking an ESL listening comprehension course in addition to their regular courses of study. These students were of mixed but predominantly Asian and Pacific ethnic and linguistic background.

Some placement test scores and standardized test scores were available on these students which were used later in the analysis of the results.

5.3 Design and procedures

The four versions of the lecture were assigned at random to

different classes in the respective subject groups. (3) The researchers met the subjects at their regular class times with the teachers present, and explained the purpose and procedure of the study. Whereas the pre-university group were met in their classrooms, the university group met the researchers in a language laboratory, where each subject could do the exercise in an individual laboratory booth. The subjects were given a two-page set of instructions with examples of how to do the cloze procedure, and of true-false and multiple choice responses. They were then given two short practice listening passages employing the cloze procedure, followed again by comprehension questions. No note-taking was allowed. (4)

Following the completion of the lecture, the cloze response booklets were collected, and the subjects were given first the multiple choice questions to answer, then the true-false quizzes.

5.4 Analysis

All the subjects' responses were scored either right or wrong. An exact word scoring method was used for the cloze items, with only minor errors in spelling or grammatical form being considered acceptable. (5)

Pearson product-moment correlations were calculated between the dependent cloze and comprehension measures and the various standardized and placement test scores for the subjects. (6) The dependent measures were analyzed separately in an analysis of covariance (SPSSX MANOVA procedure, SPSS Inc., release 1.1), with lecture version the independent factor (four levels), and different standardized and placement tests as covariates. (7)

Unexpectedly, the placement scores for the pre-university group consisted of three test administrations, separated by six month intervals. As a result, the analysis was conducted on two separate subgroups, each representing a test administration. This left an N of 33 in the one group and 32 in the second. The third group was too small for further analysis.

In addition, a priori comparisons were made according to the hypothesized direction of effect between the lecture versions. Thus, the Micro-macro version was tested against the Macro version, the Macro against the Micro, and the Micro against the Baseline. Where a significant ANCOVA was obtained, post hoc comparisons were also made to determine which versions were different from others.

6. Results

The results will be reported separately for the two groups.

Pre-university group

The cloze measure for this group as a whole was very low (X = 19.6, out of 79 possible). Table 2 reports the means for the group as a whole and separately by both version condition and by test group (test date one -- TD1 -- was the winter of 1984, test date two -- TD2 -- was late spring of 1984). Whereas the cloze had a KR-21 of .87, considered adequately high, the multiple choice and true false tests were so low in reliability (.2 and 0.16, respectively), that they will not be considered in the analysis of the lecture versions here.

Insert Table 2 about here

Table 3 shows the results of the Analysis of Covariance on this cloze measure, as differentially affected by the lecture versions, for TD1 and TD2. The version means as adjusted by the covariates are also displayed here for TD1.

Insert Table 3 about here

It is evident in Table 2 that there was a significant effect for version on cloze responses with TD1 ($F(3/27) = 4.99$, $p < 0.01$), but not TD2. The a priori comparison of differences between means showed that there were no differences between the adjusted means for the Micro version and the Baseline. Supporting the hypothesis, the Macro version was significantly superior to the Micro version ($p < .01$), but in conflict with the hypothesized effect, it was superior as well to the combination Micro-Macro version. Post hoc comparisons revealed no differences between the Micro-macro and the Micro or Baseline versions.

It was therefore of some interest to determine what difference there might be between the two test groups. Based on the cloze recall outcome and all other placement test scores, the later test group (TD2, summer 1984) performed significantly better than the earlier one (t-tests, $p < .005$). The relevance of this difference will be discussed below.

University group

The mean cloze score for the university group was 35.8

(n=81), considerably higher than the pre-university group. Table 4 reports the means for the group as a whole and separately by version condition. The cloze in this case also had a high reliability (KR-21 r=.89) and the multiple choice and true false tests improved in reliability (.32 and .39, respectively), but not enough to warrant their being included in further analyses.

Insert Table 4 about here

Table 5 shows the results of the Analysis of Covariance on this cloze measure, as differentially affected by the lecture versions. The version means as adjusted by the covariates are also displayed here.

Insert Table 5 about here

Just as with the TD1 pre-university group, Table 5 shows that there was a significant effect for version on cloze responses ($F(3/76) = 3.10$, $p < .05$), adjusting for the listening placement scores as covariate. The a priori comparison of means showed in this case that there were no differences between the adjusted means for the Micro version and the Baseline, nor between the Micro-Macro and Macro versions, but that the Macro version was again significantly superior to the Micro version ($p < .01$). Post hoc comparisons revealed no differences between the Micro-macro and the Micro or Baseline versions, although in this case the Micro-macro version appeared to produce better results than the Micro or Baseline.

Since the cloze measure was also significantly correlated with the reading placement test scores, and it could be argued that the cloze is a reading measure as much as a listening measure, these scores (which were available on nearly all subjects, N=79), were used as a second covariate. Very similar results were obtained.

To summarize, what we have found is a consistent result across groups that Macro markers, that is, the higher order discourse markers signalling major transitions and emphasis in the lectures, are more conducive to successful recall of the lecture than micro markers, that is, lower order markers of segmentation and intersentential connections. This was a significant difference in the case of the university group and the less proficient pre-university group, and a similar trend was shown for the TD2 pre-university group.

7. Discussion

In light of the theory of information processing and top-down comprehension of discourse, the finding that macro markers led to better recall of the text material than micro markers should not be surprising. The learners are evidently aided in organizing the major ideas in the lecture from the guidance of the lecturer's signals of major segments and emphasis. These help them construct appropriate schematic models of the major portions of the lecture, even if they lack sophisticated understanding of the content or the rhetorical structure of expository speech.

Why do the micro markers not aid the learners' retention of

the lecture content? For one reason, these markers do not probably add enough content to make the subsequent information more salient or meaningful. For another, the quantity of the markers scattered throughout the lecture probably result in making the entire lecture merely appear less well organized, a notion that is implied in research by Hiller, Fisher and Kaess (1969), who found that hesitation markers and vagueness in teachers' classroom speech detracted from learners' retention of instructional content. Third, it may be that the baseline lecture version was already slow enough for these learners to derive the most benefit possible from the pace of the lecture, and no further segmenting or slowing down of the pace of delivery of important information would aid further retention of information. Fourth, however, there is the possibility that the dependent measures were simply not sensitive enough to the differences in comprehension between listener groups. However, the virtual identity of the means for the Baseline and Micro versions suggests that this is not the case, or if it is, then it would require only the most sophisticated experimental techniques to reveal a difference, in which case there would be little practical application to teaching situations.

A second issue concerns why the Macro version was consistently superior to the combined Micro-macro version. Artefactual explanations come first to mind. Perhaps the particular groups hearing these passages were less proficient, or the actual recording of the version was inferior in some respect. However, there is no reason to suspect either of these explanations. For one, the pre-tests showed that the different

groups were quite homogenous in proficiency. Second, subjective listening to the lectures produces no impression of differences in quality among any of the versions. The only obvious differences are those of length, yet the total length should not have been an inhibiting factor for the Micro-macro version, since it was interrupted at the same regular cloze intervals as the others. The only evident explanation is that the further addition of micro markers to the macro markers achieved the same result as the Micro version alone: it increased the listeners' attention requirements without adding valuable information in any way, thereby detracting from the effect of the macro markers alone.

A rather important point arises from this apparent differential effect of macro and micro markers. Whereas the micro markers included here are of relatively lesser semantic value in the lecture information, and often do little else than allow the speaker time to plan the next utterance, the macro markers are explicit expressions of the planning of the lecture information. In using micro discourse markers, the speaker is merely succumbing to the necessities of on-line discourse production, while in the case of macro markers, the speaker must devote some attention to the particular phrasing and placement of the expression. The anticipation and processing by the listener follows accordingly: one learns to disregard all the minor pause fillers and redundant intersentential connectors, perhaps making use of the time to process the signficant parts of the text. But on the other hand, the listener knows that paying attention to

markers of the overall organization of the text is a critical skill for the comprehension of the information conveyed by the lecture.

A final comment is warranted concerning why the TD2 group did not evidence a significant effect like the TD1 pre-university students and the university group. One explanation is that these subjects may have been a more homogeneous group, since they were predominantly recent arrivals in the U.S., just enrolling in the summer session of the intensive program, and relatively homogeneous in ethnic and language background. In these respects they were different from the other groups, who were longer residents of the U. S. and were more diverse ethnically. It is possible that greater familiarity with the language (and therefore, facility with bottom-up processes like word recognition and sentence parsing), owing to longer residence, allows the higher level, top-down processing to play a greater role in listening comprehension.

8. Conclusion

We have attempted here to explore the relationship between modifications in oral discourse and their effects on second language learners' comprehension of the information conveyed. This issue is of ultimate importance not only for the language teacher who trains L2 learrers in listening skills, and the curriculum developer who devises a program or materials that achieve that training, but also for teachers and lecturers who teach content subjects to non-native learners.

The most immediate implications of this study are for these teachers and lecturers. It is important to realize that a

lecture read from a written text will usually lack the kinds of macromarkers found in the more conversational style of teaching. A lecture which uses more macromarkers is likely to be easier to follow. On the other hand, an overuse of micromarkers possibly detracts from the overall coherence of the lecture. For the curriculum and materials developer, and for L2 teachers, the macromarkers probably constitute a relevant focus for second language classroom activities and instructional materials. Such a focus is often lacking in current published materials.

Further research, however, is necessary to replicate the present findings, and to determine whether materials and instruction which exercise learners' recognition of such markers bring about a higher level of comprehension.

NOTES

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1. The total duration of the lectures varied between 23 and 27 minutes because of the added material in each of the versions from Micro to Micro-macro. These times include eight minutes of pauses, because there were 13 pauses of 40 seconds inserted at systematic intervals, as described in the next section.

2. At about one to one-and-a-half minute intervals, a 40 second pause was inserted into all the versions of the lecture. Corresponding to each pause, a special response answer sheet in a bound booklet was prepared which summarized the lecture content as a short text, virtually verbatim from the lecture, but with six or seven selected vocabulary items deleted as cloze items. On hearing a tone, the subjects turned a page in their answer booklets, and filled in the blanks in the short passage in the booklet. A second tone indicated the end of the pause, at which point they were to be prepared to listen again. There were 13 such pauses in the lectures, and a total of 79 cloze items. The duration of the response pause was intentionally short, and the subjects were prohibited from reading the passages ahead of the

interruption by a shielding mechanism, in order to enhance the effectiveness of the test as a measure of short term recall, rather than as a measure of reading ability.

3. Due to obviously unequal numbers of subjects in some classes, and to the fact that the pre-university subjects were divided into two ability levels, several classes were split up at random into different lecture version treatments, in order to obtain as balanced a distribution as possible across lecture versions of subjects of different abilities.

4. During the practices, the researchers observed to make sure that the subjects were performing correctly, and not looking ahead at the cloze passages until the proper interruption in the lecture. As an aid for the subjects to follow references to geographical areas in the lecture, a dittoed map of the United States was provided. It is believed that the majority of the subjects learned the procedure quite readily, and only a few needed to be reminded during the first few interruptions not to look ahead at the cloze passages or to take notes.

5. Prior research with cloze procedures has demonstrated that an acceptable word scoring only slightly increases reliability (and of course eases difficulty), but in this procedure, it was felt that only an exact word scoring would technically qualify as a correct measure of <u>listening</u> comprehension, rather than reading comprehension.

6. Due to missing data in some cases, not all analyses could include the total number of subjects. Kuder-Richardson 21 reliability estimates were also made of the dependent measures. Although this is ordinarily not considered appropriate for a

cloze test, the fact that only one right answer was considered warranted using this generally conservative estimate.

7. The reason for using covariates is that variance in proficiency should be removed from the dependent measures in order to determine the difference between the four versions independently of learners' ability. The cloze measure was highly correlated with the placement test scores (r ranged from 0.39 to .56, $p < .001$, between the cloze, and listening, reading and TOEFL scores for the groups), so especially the listening placement tests, for which all subjects had scores, were used as covariates (Michigan and CELT tests for the pre-university group, and the Plaister Auding Test for the university group).

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Table 1

Duration and Rate of Lecture Versions

Lecture version	Duration (includes 8 min. of pauses)	Words	Rate (wpm)
Baseline	23:02	1760	117.3
Micro	24:46	1910	114.0
Macro	25:46	1914	107.8
Micro - macro	27:17	2064	107.1

Table 2

Means on Cloze Recall for Pre-university Group

Lecture Version	TD 1 (N=33) Mean	s.d	TD 2 (N=32) Mean	s.d
Baseline	18.5	±7.7	25.0	±8.3
Micro	9.83	±5.4	20.42	±10.5
Macro	24.1	±10.1	22.17	±8.3
Micro - macro	13.17	±8.4	23.09	±12.9
Overall Means	17.48	±9.4	22.18	±10.5
Grand Mean		19.8		

Table 3

Analysis of Covariance of Cloze Scores by Version

Source	SS	df	MS	F	
a) Test date 1					
Constant	.78	1	.78	.01	
Regression (covariates)	473.41	2	236.71	4.3	*
Version	822.71	3	274.24	4.99	**
Within	1484.14	27	54.97		
b) Test date 2					
Constant	173.10	1	173.10	2.49	
Regression (covariates)	1592.86	2	796.43	11.47	***
Version	244.82	3	81.61	1.18	
Within	1804.88	26	69.42		

* p < .05
** p < .01
*** p < .001

Version	Adjusted mean (TD 1)
Baseline	16.08
Micro	12.01
Macro	25.61
Micro - macro	13.58

Table 4

Means on Cloze Recall for University Group

Lecture Version	N	Mean	s.d.
Baseline	18	31.89	±9.4
Micro	26	32.12	±13.59
Macro	18	42.94	±10.18
Micro - macro	19	37.95	±14.3
Overall Mean	81	35.8	±12.84

Table 5

Analysis of Covariance of Cloze Scores by Version

Source	SS	df	MS	F
University Group				
Constant	64.14	1	64.14	.49
Regression (covariates)	1592.84	1	1592.84	12.14 ***
Version	1218.40	3	406.13	3.10 *
Within	9967.43	76	131.15	

* $p < .05$
*** $p < .001$

Version	Adjusted mean
Baseline	32.98
Micro	32.33
Macro	42.21
Micro - macro	37.32